Case Study: Shared Savings and Low-Cost Lighting Improvements at Shangshi Tower, Shanghai

Building Summary

Shangshi Tower is a 67,000 square meter, 40-story commercial office tower located in the Xuhui district of Shanghai. The building has been in operation since December 1996.

Actions Taken

Building management staff at Shangshi Tower improved building energy performance by making low-cost lighting upgrades and working with an Energy Service Company (ESCO) to install an HVAC energy conservation control system as a part of its central cooling system. This strategy allowed the building to achieve substantial energy savings while keeping costs for equipment upgrades minimal. The use of an outside energy service consultant and energy performance contract (EPC) for the installation of the HVAC system ensured that the building would avoid making substantial start-up equipment investments, but would be able to implement a successful long-term energy-saving strategy.

- Garage and Equipment Room Lamp Replacements: The building includes a parking area with three levels of indoor parking and one equipment room. Lighting levels in these areas were found to be excessive for their use requirements. This allowed the building management team to replace 350 of the 544 existing 48-Watt lamps with lamps that use only 28-Watts. The replacements resulted in significant savings equivalent to approximately 42% of previous electricity use in these two areas of the building.
- Use of Building Automation System to Reduce Lighting Operation: In addition to reducing lighting levels through lamp replacements, the building management team identified an opportunity to reduce the time that some of the lights were used after business hours. It was determined that approxmiately 75% of garage lighting was not necessary between 12:00 a.m. and 7:30 a.m. The building automation system (BAS) was programmed to split the lighting into two zones that could be controlled separately. The BAS was then programmed to turn 160 lights off during a 7.5-hour period and 120 lights off during a 12-hour period. This adjustment resulted in an additional 18% reduction in annual electricity use in these areas of the building.
- Installation of HVAC Energy Conservation Control System: Shangshi Tower uses three central chillers to provide cooling to the building. This includes one 400-ton chiller and two 900-ton chillers, three 30-kW and two 37-kW cold water pumps, and three 75-kW cooling water pumps, all of which contribute to high energy consumption. Before the installation of the energy conservation control system, the system cooled and distributed water at a constant flow rate, regardless of the building's actual cooling demand. Since most central chiller systems only reach peak flow load a few hours per year, energy is often wasted by continually running the system's chilled water pumps at a constant flow

rate. Substantial energy savings can be achieved by matching the flow rate to the systems's actual cooling needs.

An energy conservation control system was installed which included variable speed drives (VSD) and an enhanced electronic control system that works with the building's existing control system. This system was able to control the speed of pumps and the flow of chiller water to the coils in the air handling units (AHUs). This allows the flow of chilled water to match the needs of the building, based on thermostat set-points, resulting in more than 20% energy savings. The installation of the HVAC energy conservation control system was able to accomplish two things: first, as the HVAC system load varies, the system adjusts pump speed to maximize efficiency and reduce energy consumption. Second, more efficient operation reduces pump breakdown and prolongs the pump life.

Results

The lighting retrofit and lighting control measures resulted in electricity savings of 7,257 kWh per month, or 87,091 kWh per year. This is equal to a 60% reduction in electricity use and an estimated cost savings of RMB 69,672 annually (US $9,009). The estimated cost of the lighting retrofit was RMB 38,500, indicating a payback period of approximately 6.6 months.

The addition of energy conservation control system to the building's cooling system resulted annual average energy saving of 23%. The energy savings for the 2006 cooling season totaled 306,561 kWh, equal to RMB 245,247 (US $31,711). These savings resulted from a reduction in electricity use during the six-month period of central cooling system use (cooling system not used for remaining six months of the year).

2006 Energy Savings

Month	May	June	July	August	September	October	Total
Electricity saving (kWh)	24,094	55,957	67,373	64,614	53,038	41,485	306,561
Cost saving (yuan)	19,275	44,765	53,898	51,691	42,430	33,188	245,247
ESCO share (yuan)	16,384	38,051	45,814	43,938	36,066	28,210	208,463

There was no up-front cost of the VSD installation for the building, based on the innovative shared-savings approach taken by the building and its energy service consultants at Guizhou Huiton Huacheng Building Science and Technologies Co., LTD. The installation and maintenance of the system was paid for by Guizhou Huiton Huacheng, with an agreement that Shangshi would pay the company 85% of the electricity cost savings for five years. After five years, Shangshi would own the system and could retain all the future energy savings. Electricity meters were installed on the central chiller system to determine baseline energy use before installation of the energy conservation system, and are monitored regularly over time to develop agreed savings for both parties.

Contact Information

For more information on the eeBuildings program, to find out about upcoming trainings and events, or for general information on how to reduce building energy consumption using simple, no-cost and low-cost operational measures, go to www.epa.gov/eeBuildings or write to eeBuildings@epa.gov.